bio-protocol Preprint

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Computational modeling

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An abbreviated version of this protocol was published in Science Advances in Jul 2021

Intercellular coupling between peripheral circadian oscillators by TGF-β signaling

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Detailed protocol

Hi!

Thanks for your interest in our paper. We did not model explicitly the interaction of TGFb with additional genes. We simulated each individual oscillator (i.e. each individual cell) by taking a phenomenological amplitude-phase model (as described in the Materials and Methods -- computational modeling section). In these models, one only has two variables, namely the amplitude and phase of the oscillations. Thus they do not explain in molecular details what's happening with genes or proteins of the circadian clock network, but rather these models are a generalization of any biological oscillator. One can simulate these models either in polar coordinates (taking the amplitude and phase variables), or in Cartesian coordinates, by converting the amplitude and phase into the Cartesian coordinates x and y. The resulting ordinary differential equations in Cartesian coordinates are given in the materials and methods section.

In order to model the interaction between individual oscillators (i.e. the coupling by means of TGFb), we assumed that a network of 200 oscillators is synchronized by a mean field M, which is nothing but the average concentration of xi across all 200 simulated cells (equation 5 of Materials & Methods). For this reason there's the M term appearing in equation (1) from the Materials and Methods section. You can read more about mean-field synchronization to model circadian oscillators in the following paper: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1366510/

I hope this answers your question! If not, don't hesitate to contact me on marta.del-olmo@charite.de. I can share my code with you if that helps.

Best regards from Berlin,

Marta del Olmo

How to cite:(Readers should cite both the Bio-protocol preprint and the original research article where this protocol was used)

1. Finger, A. , Olmo, M. and Kramer, A. (2021). Computational modeling. Bio-protocol Preprint. bio-protocol.org/prep1390.
2. Finger, A., Jäschke, S., Olmo, M. D., Hurwitz, R., Granada, A. E., Herzel, H. and Kramer, A.(2021). Intercellular coupling between peripheral circadian oscillators by TGF-β signaling . Science Advances 7(30). DOI: 10.1126/sciadv.abg5174

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